NORTHUMBERLAND SEA FISHERIES COMMITTEE.

REPORT

— ON THE —

SCIENTIFIC INVESTIGATIONS

For the Year 1910, and to June 15th, 1911,

Edited by Professor ALEXANDER MEEK M.Sc.,

Armstrong College (in the University of Durham), Newcastle-upon-Tyne. Director of the Dove Marine Laboratory, Cullercoats, Northumberland

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CONTENTS.

SUMMARY AND GENERAL REPORT.

The "Evadne" was used during the past year for a few trawling experiments which furnished additional records of the conditions of the Bays at the critical periods when the fish are in the process of leaving and returning to the inshore waters.

As enquiries have been sent to us as to the results of the Northumberland marking experiments, and as the records are scattered over a number of reports, some of which are becoming very scarce, a synopsis is now given with tables and charts. This shows what has already been accomplished, and it serves to indicate also that a great deal of experimental work in this direction remains to be done.

The experiments in Lobster Culture were an advance on those of the previous year. There was not a large number of larvæ from the berried lobsters, but we managed to rear a few to the lobsterling and the succeeding stage. As a result we are beginning to recognise some of the factors essential to success.

Few people have actually witnessed the moulting or ecdysis of the adult lobster, and an account of the process based on the observations of the Laboratory Attendant, J. A. Taylor, will be found to be interesting and valuable. It was J. A. Taylor also who drew our attention to the fact that lobsters could be thrown into a sort of mesmeric state by simply rubbing them along the back of the carapace, and this led to a few experiments which are described as "Mesmerising Lobsters and other Crustaceans."

The Mussel Culture experiment at Holy Island has resulted in showing that there is a vast area on Fenham Flats capable of supporting mussels for bait and also for marketing for food. A beginning could be made by bringing together the already large quantities of mussels on the Flats, so extending the mussel bed now formed, and particularly by

transplanting the young mussels to the scaup. The experiment has shown also the value of the attention which would be given if the area were taken over and worked on commercial lines. How this may best be accomplished is yet to be settled.

The present report includes likewise an account of interesting observations on the spawning habits of the Cod, a paper on the development of Pycnogons by Mr. V. Dogiel of the Imperial University of St. Petersburg, Notes on Nudibranchs by Mr. Storrow, and Faunistic Notes.

With regard to the Laboratory we have pleasure in stating that the continued kindness and interest of the anonymous donor enabled us last year to add a picturesque seal pond, and this year he has given us the means to duplicate the large storage tank, the pumping equipment, with the necessary pipe connexions, and at the same time to provide an additional storage room under the existing tank. There will thus be two pumps, so that the danger of a breakdown will be guarded against. The two storage tanks, each of 15,000 gallons capacity, will allow of the water being settled before introducing it to the private and public aquaria.

Much valuable work in gathering and recording our local fauna has been done with the aid of the "Evadne," and the motor boat has also been used in bringing live material to the Laboratory and berried lobsters for the experiment in Lobster Culture, in trawling experiments, and in visiting the mussel bed at Holy Island.

Mr. B. Storrow was appointed Assistant Naturalist and entered upon his duties at Easter. He has begun a study of the Norway Lobster, and has been occupied to a large extent in analysing and classifying the material brought in by the "Evadne" and by the fishing boats. He has given valuable help to workers occupying the Laboratory tables.

Tables have been occupied by Mr. Sisson, Major Bishop, Miss Lebour, Mr. V. Dogiel, Dr. J. Stuart Thomson, and several members of the Northumberland Coast Club, especially Mr. W. H. Young and Mr. L. Wood.

The Marine Laboratory Committee applied to the Treasury for a grant in aid of the scientific work done in connexion with the Laboratory, and the application was supported by resolutions passed by the Northumberland Sea Fisheries Committee, and the Northumberland County Council. The application was sent to the Commissioners appointed under the Development Act, and was referred to the Board of Agriculture and Fisheries. We have been informed that a general scheme has been prepared and forwarded to the Commissioners by the Board of Agriculture and Fisheries—a scheme which includes our application with others of a similar nature.

ALEXANDER MEEK.

DOVE MARINE LABORATORY, CULLERCOATS.

TRAWLING EXPERIMENTS.

It was not originally contemplated that the "Evadne" would be capable of carrying on experiments with such heavy apparatus as that involved in trawling. But after trying several times with the smaller dredging nets it was felt that she might be able to do the trawling experiments as well. The experiments were postponed, therefore, until a capstan, which had been ordered as part of the equipment of the boat, had been installed. This was done about the end of August, and on September 2nd, the gear, which had before been employed on board the steamers hired by the Committee, was tried in Blyth Bay. The results are given in the accompanying tables. It was found that the "Evadne" was quite equal to the work, but as the net appeared to be heavy, a smaller trawl was obtained. Several trials were made with the latter, but in each case the results, so far as the net was concerned, were quite disappointing.

The old gear was therefore reverted to, and in spite of the fact that usually the experiments were done with only four persons on board, viz., Fishery Officer Taylor, the Laboratory Attendant, the "Evadne's" Engineer, and myself, it was found possible to carry on the work with practically the same expedition as on the larger boats. The accompanying figures illustrate this. They show that the "Evadne" is very suitable for doing the work, and that the net furnishes results which are perfectly trustworthy and which can be compared with those of previous experiments. Purposely to determine these points I gave 1½ hours to Alnmouth Bay and Druridge Bays at an interval of a week. If the tables be compared it will be seen that the catch in each bay on each occasion was almost exactly the same, not only with regard to numbers, but species, and size. I do not intend at present to correlate the figures obtained this year with those obtained before, but I wish to draw attention to the contrast between the two bays with reference to the size of the fish. At Alnmouth Bay a large number of small plaice was present on each occasion, whereas in Druridge Bay the large plaice were

most conspicuous. Some very large deep sea plaice were included. The same could be said with reference to the other species.

This is not to be taken as evidence that Alnmouth Bay is a better nursery for small flat and other fish than Druridge. But rather that the small flat fish have already begun their annual migration from Druridge Bay.

For a number of reasons it was found impossible to continue the experiments until March, when a few experiments were made. These showed that early that month the bays and even the deep water at Coquet Smooth were in the winter condition.

For this reason and the further reason that I desire to get time to consider commercial results, and to obtain further information from this source, I have decided to postpone the analysis I propose to make of the winter migration.

First Haul. BLYTH BAY, September 2nd, 1910.

Began 9·45 a.m., ended 10·45 a.m. Time, 1 hour.

INCHES.

Name of Fish.	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total
Plaice		8	8	...	1	...	3	2	4	1	3	..	...	...	...	...	30
Dab	...	8	60	34	11	...	1	...	...	...	...	...	...	...	...	...	114
Sole	.	...	...	..	...	...	.	...	...	...	1	1	...	...	...	...	2
Turbot	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	1
Gurnard	1	1	1	1	1	...	1	.	...	...	...	...	..	...	...	...	6
Angler	...	2	...	...	1	...	1	...	...	...	...	...	...	...	...	...	4
																	157

First Haul. BLYTH BAY, September 2nd, 1910.

Began 11·10 a.m., ended 1·10 p.m. Time 2 hours.

Beam upset, therefore not satisfactory.

INCHES.

Name of Fish.	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total.
Plaice ...	1	7	7	1	2	...	2	3	5	1	1	...	...	...	...	...	30
Dab ...	...	...	7	42	21	4	1	...	...	...	...	...	...	...	...	...	75
Sole ...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	1
Turbot ...	...	...	...	...	...	...	...	2	2	3	1	...	1	...	...	...	9
Gurnard ...	2	1	3	5	5	5	6	4	1	1	1	...	...	...	...	...	34
Angler ...	...	...	...	2	...	...	...	...	1	...	2	...	...	...	...	1	8
																	157

2 more ca. this size overboard.

First Haul. **ALNMOUTH BAY**, September 30th, 1910. Began 12 Noon, ended 1·30 p.m. Time, 1 hour 30 minutes.

CENTIMETRES.

Name of Fish	1	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Total.
Plaice			2	3	28	23	11	5	1		4	3	2	5	8	4	4	4	7	3	6									1												124
Dab				1				3	4	7	16	14	13	6	4	5	2	1	1	1	1	2																				81
Sole																																1										1
Turbot																															1											1
Gurnard				2	11	2	2		4	2	1	3	1							1						1																30
Angler													1	1																													2
																																									239

First Haul. **DRURIDGE BAY**, September 30th. Began 2·25 p.m., ended 3·55 p.m. Time 1 hour 30 minutes.

Plaice					5	4	1		1			1			1		2	2	1	1		1	2	1	1		1		2	2	2	1		1						$^{5,7}_{1}$	34
Dab								1	1	4	8	15	9	5	8	3	1	2									1															58
Sole																										1			1				1	1		1						5
Turbot																						1					1											1			$^{5,4}_{1}$	4
Flounder																1																											1
Gurnard										1	3	1	11	5	9	6	8	5	2	1	2	1	1	1	3	2	1															63
Angler												1				1									1																		3
																																									168

First Haul. **ALNMOUTH BAY**, October 6th, 1910. Began 12 noon, ended 1·30 p.m. Time, 1 hour 30 minutes.

CENTIMETRES.

Name of Fish.	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Total.
Plaice ...	...	...	1	3	34	36	19	4	5	...	4	2	3	2	2	3	5	1	3	3	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	132
Dab ...	...	...	..	1	...	...	3	3	6	12	20	13	7	8	3	6	5	...	...	2	1	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	92
Sole ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1
Turbot ...	..	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	..	...	...	...	...	...	...	...	...	...	...	...	...	...	$\frac{5.8}{1}$	1
Gurnard ..	..	...	.	2	...	1	...	...	3	3	2	1	4	...	...	1	...	...	...	1	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	19
Angler ...	..	..	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	1	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	1	...	...	...	...	...	...	...	6
																																										251

First Haul. **DRURIDGE BAY**, October 6th, 1910. Began 2·30 p.m., ended 4 p.m. Time, 1 hour 30 minutes.

Plaice ...	...	..	..	1	1	6	4	2	...	1	..	..	..	..	..	1	...	...	1	1	3	5	4	2	2	1	..	1	2	1	...	...	1	...	...	...	...	...	1	...	$\frac{6.0}{1}$	42
Dab ...	...	...	...	...	...	1	...	1	1	3	5	11	5	7	5	5	5	..	3	3	1	...	...	..	...	..	1	..	...	...	...	...	...	...	...	...	...	...	...	...	...	57
Sole ...	...	...	..	..	...	...	..	...	..	...	...	..	..	...	..	..	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	2
Turbot ...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	2	...	...	...	...	...	1	4
Brill ...	...	...	...	...	...	...	...	..	...	..	..	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	..	1
Flounder ...	...	.	..	...	...	.	...	...	..	..	...	...	...	...	...	.	..	...	...	1	1	...	..	..	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2
Gurnard ...	...	...	..	...	...	...	...	...	...	...	...	2	3	2	2	1	3	5	2	3	2	3	4	5	4	2	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	44
Angler ...	...	...	...	...	...	...	...	...	...	...	..	..	...	...	...	...	..	...	...	.	..	...	...	..	..	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1
																																										153

CENTIMETRES.

Name of Fish.	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	Total.
Plaice						3	7		2				1	3		2	4	2	1	2	1	3		1	1	1		1															35
Flounder																				1																							1
Cod																																								6 1	2 1	1
																																									37

First Haul. DRURIDGE BAY, March 6th, 1911. Began 11 a.m., ended 12·30 p.m. Time, 1 hour 30 minutes.

Plaice																		1		2	3		1	2		1	1	1	1														13
Dab																			1																								1
Cod																											1												6 1	7 1	2	3
Thornback																			2																								2
																																										19

First Haul. ALNMOUTH BAY, March 6th, 1911. Began 1·20 p.m., ended 2·20 p.m. Time, 1 hour.

Dab																		1																									1
																																										1

First Haul. COQUET SMOOTH, March 6th, 1911. Began 2·50 p.m., ended 3·50 p.m. Time, 1 hour.

Thornback							1																																				1
																																										1

MIGRATION EXPERIMENTS.

(*a*) INSHORE FLATFISH.

In the year 1903 certain of the fishes taken when trawling in the inshore waters were measured and after being labelled were returned to the sea. This was done also when opportunity offered in the following years; and the results are now given for all the experiments in the accompanying synoptical tables and charts.

The fish marked and liberated included plaice, dab, flounder, turbot, sole, brill, catfish, and thornback. No records of recapture have been obtained for the last four mentioned, and this is probably due to the fact that only 13 soles, 1 brill, 1 catfish, and 2 thornbacks were dealt with.

Tables 1 to 4 show on the left the number marked and liberated at each experiment, together with the size of the largest and smallest and the mean size of the fish dealt with. To the right the tables are arranged to show the period intervening between liberation and recapture, the distance travelled in this period, and the size of the fish recaptured; whilst further division shows the same facts for males and females. As notification of recaptures has in some cases only been accompanied by the label it has been necessary to add another column to the tables for fish of unknown sex.

In considering the distance travelled before recapture it has been assumed that where there is migration of over 10 miles the fish have left the district and thus the tables give no idea as to the enormous amount of migration which has taken place in some cases, and which is probably best shown by means of the charts.

Table 5 is a summary of the previous tables and gives the total numbers of fish liberated and recaptured, the percentage of recaptures, and facts relating to migration and size for the whole of those recaptured, and similarly for males and females. The fish of which the sex is unknown have not been in this case separately considered, but are included in the total number recaptured.

The Charts 1 to 4 show approximately the position where the marked fish were recaptured. As many of these were taken in inshore waters not far from the place of liberation

the number so taken is shown to the right of the symbol used for each bay where the fish were liberated. No attempt has been made on the charts to indicate the time taken to make the migration, but this factor is stated in the tables, and full particulars are given in preceding reports.

Plaice.—Table 1, Chart 1.—The total number liberated was 531, and of these 470 were dealt with in 1903, 7 in 1904, and 54 in 1909. The recaptures numbered 76 or 14 per cent. Only 9 were obtained which show migration of over 10 miles. Of the fish captured at a distance of less than 5 miles from the place of liberation 57 were accounted for in the first year and the remainder (7) in the second year. The amount of migration is not, however, controlled altogether by the period of liberation, for amongst those migrating over 10 miles 3 were captured in the first year—one travelling 42 miles in less than six months, another 51 miles in less than five months, and the third 35 miles in eleven months. Amongst the remaining 6 which left the district are 3 for which the locality of recapture is unknown. They were sent from Aberdeen, Grimsby, and London respectively. These fish must have left the district, in fact they must have migrated to a considerable distance to be captured by any but local trawlers.

The general direction of migration for the six, of which we have the information as to locality (with one exception which was caught 29 miles E.S.E. from the place of liberation), is northerly, one going as far as the Moray Firth in less than two years.

From Table 5 it is evident that the determining factor in migration is approaching maturity. The mean size of the plaice which left the district is 35·8 cm., the smallest being 29 cm. The mean size of those which did not leave the district is 26·6 cm., the largest being 34·3 cm.

r Reports, 1903, p. 36; 1904, p. 72; 1905, p. 56; 1909, p. 17.

Dab.—Table 2, Chart 2.—The total number liberated was 768. Of these 9 were set free in 1903, 432 in 1904, 290 in 1905, 28 in 1906, and 9 in 1907. The number recaptured was 37, or 4·8 per cent. Only 7 had migrated more than 10 miles, 5 of them being captured in the first six months,

1 in the second six months, and 1 in the third six months. The mean size of those migrating over 10 miles is 22·3, the smallest being 17·8, and the mean size of those showing little or no migration is 21·9, the largest being 26·7 cm. There is therefore no connexion which can be pointed out as to the relation of size and maturity to migration. It has already been apparent from the trawling records that an important annual migration of dabs takes place from the shore into deeper water. Some of these at all events return to the inshore regions again. In two cases of which we have record the return was to a bay to the south of the place of liberation, viz., from Skate Roads to Druridge Bay, and from Alnmouth Bay to Cambois Bay. It is interesting in this connexion to point out that in the case of those which were recaptured beyond the district the recaptures were made, three of them in October, and the remaining two in January and February, that is to say, during the period of the annual winter migration.

The general direction of migration therefore appears to be southerly. The furthest distance south reached by one of the dabs is Scarborough South Bay, a distance of 60 miles in 166 days.

r Reports, 1904, p. 74 ; 1905, p. 56 ; 1906, p. 25 ; 1907, p. 21.

Flounder.—Table 3, Chart 3.—The total number liberated was 382, viz., 25 in 1904, 42 in 1905, 154 in 1906, and 161 in 1907. The recaptures number 77 or 20·2 per cent. Nineteen show migration of over 10 miles, and of these 17 were caught in the first year. The mean size of the recaptured flounders which migrated more than 10 miles is 30·7 cm., the smallest being a male of 18·5 cm. The mean size of those which migrated less than 5 miles is 26·2 cm., the largest being 35·8, sex unknown.

As in the plaice so in the flounder approaching maturity appears to be the prime factor in migration. In all cases where examination was made of the flounders migrating more than 10 miles, they were found to be mature or spent.

The general direction of migration is northerly, several being recaptured in the Firth of Forth and St. Andrew's Bay, one going so far as Aberdeen. Two, however, show migration to the south, one to Filey and the other to the east of

Hartlepool. Two had migrated in a southerly direction in the district, viz., one from Alnmouth Bay to Cresswell, and the other from Blyth to Tynemouth. It will be seen from the chart that with one exception the flounders were recaptured at no great distance from the shore, and if the particulars in previous reports be consulted examples will be found of recapture in estuarine waters.

v Reports, 1905, p. 57 ; 1906, p. 25 ; 1907, p. 21 ; 1908, p. 31.

Turbot.—Table 4, Chart 4.—The total number liberated was 85, viz., 1 in 1903, 4 in 1904, 36 in 1905, 18 in 1906, 22 in 1907, 2 in 1908, and 2 in 1909. The recaptures number 6, or 7 per cent., and the amount of migration and its direction, in all cases into deep water, is best appreciated by examining Chart 4. In two cases the period between liberation and recapture was more than two years, and in a third more than 1½ years.

r Reports, 1905, p. 57 ; 1906, p. 24 ; 1908, p. 31 ; 1909, p. 17.

(*b*) CRABS AND LOBSTERS.

Crabs.—Tables 6 & 7, Chart 5.—From the tables it will be seen that 781 were marked and liberated at various places along the coast of Northumberland in the years 1902 to 1905, and that 79 or 10 per cent. were recaptured. The tables are arranged to show the same facts as those used for flatfish, but size is not included, and in its place columns are provided to indicate the direction of migration. Previous reports give the necessary information as to the method of marking and the nature of the crabs employed which were in the process of hardening after casting. The results in this case at all events are perfectly consistent. The females which were at liberty for more than six months all migrated in a northerly direction along the coast, reaching in most cases the adjacent shores of Scotland, and some of them were captured on the coasts of Forfarshire and Kincardineshire. The males on the other hand so far as our records go did not show any tendency to migrate. Four males were free for more than two years and were captured in the neighbourhood of the place of liberation. In only one case has the migration been

southerly, from Newbiggin to Tynemouth, and it is possible that in this case it may be accidental, as say from being caught by a trawler and thrown overboard in the process of cleaning the nets. In this instance there is no record as to sex. It has to be kept in mind that there is an annual migration of crabs into deeper water and it is during this migration that at least the females which have recently cast segregate themselves in a northerly direction.

This experiment has, we are led to understand, been confirmed by an experiment made in the district of the North-Eastern Committee, and it will be interesting to see what result follows the experiment which is now being made by Mr. Dennison for the Eastern Committee.

v Reports, 1903, p. 35 ; 1905, p. 98 ; 1906, p. 26 ; 1907, p. 22.

Lobsters.—Tables 6 and 7.—Most of the lobsters were marked as the crabs by Mr. John Douglas, Beadnell. The total number marked was 312, 97 being females carrying eggs. Only one case of migration is recorded, that of a female which was found 10 miles north of the place of liberation. The number of recaptures is 65 or 21 per cent. of those liberated.

v Reports, 1902, p. 40 ; 1908, p. 32 ; 1909, p. 23.

LOBSTER CULTURE.

The supply of berried lobsters was obtained from Blyth, Newbiggin and Cullercoats. Some were sent to the Laboratory in boxes by train, and others were brought in a tank by the "Evadne." On arrival the lobsters were placed in the tanks of the private aquarium, from which the copper standards of the paddle apparatus used the previous year had been removed. It was suggested in last year's report that the failures were probably due to two causes, the egg capsules being allowed to become too dry during the transit of the berried lobster, and the presence of minute quantities of copper due to the action of the sea water on the copper standards. This latter surmise was proved this year by experiment. Several larvæ were removed from the tanks in which they were reared and placed in a tank, on the side of which the copper standard had been left, and they died within 24 hours.

The larvæ first appeared on June 29th, and continued to hatch until the middle of July. From these 13 lobsterlings were reared and lived in the small tanks up to the beginning of August. But during that month they died in succession, the last living until August 28th, when it was 8 weeks old. The experiment was extended by conveying on July 21st, 84 lobsters in the larval stage to a closed area. It will be interesting to see whether at this stage there is a prospect of a reasonable survival.

Some of the berried lobsters were placed in the floor pool of the public aquarium, and on September 7th six more lobsterlings were obtained from the larvæ hatched there. The larger area of the floor pool was found to be an improvement. The lobsters did not attempt to remove the eggs as they do in the narrow confines of the tanks of the private aquarium. In consequence a larger number of larvæ was obtained.

In August two berried lobsters were obtained by Fishery Officer Taylor, one from Newbiggin and the other from North Shields Fish Quay, and from these a further batch of

larvæ was got about the middle of September. Some 350 of these were placed in the tanks of the private aquarium. Of these 120 died on October 14th, and the remainder with the exception of 3 were lost in the third stage. The remaining 3 passed through the fourth stage and died on October 31st.

We are thus led to conclude from our experiences of 1910 that it is essential to retain the berried lobsters in a large pond during the period before and during hatching, and that the greatest cleanliness must be observed in dealing with the larvæ after hatching. Great difficulty was experienced in keeping the small tanks in which the larvæ were kept clean, for the water pumped from the bay was found, especially after a slight sea, to contain a great deal of matter in suspension. This settled to the bottom of the tanks, and, in spite of the tanks being frequently cleaned, doubtless caused the death of many of the larvæ when these settled on the bottom, especially when they were casting. The larvæ left in the centre pool were healthy and moved about with great vigour, many reaching the third stage, but the number was observed to diminish rapidly. This for a time could not be accounted for, as no dead were found at the bottom of the pool. The majority of them disappeared before the Laboratory Attendant found late one evening that some shore fish had been placed amongst the young lobsters by a visitor. The fish were four blennies and a three-bearded rockling, and they kept in the shelter of the rockwork during the day.

It is evident, therefore, that the small tanks used for rearing the larvæ must have a supply of water free from sediment and even certain Protozoa. So that filtering appears to be necessary. And careful feeding will do much to keep down the death rate from the cannibalistic propensities of the larvæ.

THE CASTING OR MOULTING OF THE LOBSTER.

The following observations were made by the Laboratory Attendant, J. A. Taylor: —

Casting is preceded by certain changes. The lobster gradually becomes dullish in colour, especially near the lower edge of the carapace. About twelve hours afterwards food is refused entirely. This is probably because casting has already begun in the forward region of the body, and feeding is no longer possible. About half an hour before casting actually begins the lobster lies evidently always on the left side. At this time the cephalothoracic region is being pushed backwards under the old cuticle, the appendages being released as well, and the front ring of the abdomen is also gradually freed. Then the back is lifted until the cephalothorax and abdomen are situated almost at right angles to one another. The lobster by these operations brings pressure enough to burst the very thin cuticle between the cephalothorax and abdomen, and by a continuation of them it gradually pulls the forward region clear of the carapace until a hold or purchase is obtained on the posterior edge of the carapace for the rostrum. With this as a lever the forward appendages are slowly released, the thin posterior pereiopoda and then the large chelæ. All this forward part freed, the lobster practically walks out of the old shell, releasing the abdominal portion as he does so. The time taken in casting varies from eleven to twenty-three minutes.

It might be suggested that the armature of the rostrum may therefore have some physiological relationship to casting.

MESMERISING LOBSTERS AND OTHER CRUSTACEANS.

It is known to a number of people at least that a lobster may be put into a comatose condition by rubbing it along the back of the carapace. The usual way is to hold the lobster head down with the claws arranged so as to form a support with the rostrum and to stroke it rapidly as stated with the tips of the fingers. In about a minute it will be found that the lobster will succumb and it will remain without movement in this position for a long but variable period. The Laboratory attendant, J. A. Taylor, pointed this out to me last year. And at my request he tried with success the same operation upon the Norway Lobster and the common Crab. With a view to seeing whether the reversed position, as determining the blood to the head, was essential, a lobster was treated in the horizontal attitude and so successfully that it remained without movement for three hours and was then awakened. A Norway Lobster similarly treated was quiescent for 55 minutes. It was found also that a lobster could be put to sleep on its back. The crab goes to sleep usually in the tucked-up condition—and may be left in the natural position or on its back. They all recover when disturbed, but in the case of the lobster this appears to be hastened by rubbing the under surface of the cephalothorax. Recovery is immediate when the lobsters are placed in sea water. In the case of the crab one at all events took some ten minutes after being returned to the water to come round completely.

During the sleep the scaphognathite is in action all the time and there may be movements of the appendages as well. Reflexes take place also.

MUSSEL CULTURE AT HOLY ISLAND.

It was stated in the last report that an experimental mussel bed had been formed on the scaup at Fenham Flats, Holy Island, by transplanting mussels from other parts of the Flats, and also from Blyth. The bed has now been a year in existence, and it is my intention to shortly describe the results. Samples have been brought from time to time for analysis, and some of these have been sent to the Fishmongers' Company for bacteriological examination. A large proportion of the mussels were old ones removed from the higher parts of the slake, where they were not and are not making any progress. These during the year have progressed in growth on the experimental bed, and have filled so as to form good bait mussels. But the most important change has taken place with regard to the young mussels from the lower parts of the Flats and from Blyth. I have specimens from the original bed of young mussels on the scaup, and from the experimental bed to which they were transplanted, and the difference in size between them is at once apparent. The average size at the period of transplantation of the young mussels was 4·3 cm (September, 1910). In April, 1911, the average size of the mussels on the original bed was 4·6, and of the transplanted mussels, 5·4 cm. During the year the Blyth mussels have increased by ·9 cm., and the native old mussels by ·5 to 1 cm.

Without going further into details, the experiment shows that the scaup is capable of supporting a large quantity of mussels, for bait, and that if they be kept clean they will also serve for human consumption. It clearly demonstrates also that transplantation, coupled with attention afterwards, will be met by a gratifying response in growth and development. There is a great deal of natural spatting at different parts of the Flats, and this could with more knowledge be encouraged. This has been the experience also of the Holy Island fishermen, several of whom have made it a habit to form small scaups for their own use.

The area is a large one, and could best be worked on commercial principles as a whole or by some plan by which it

could be let in a series of small holdings. While it is possible to satisfactorily do the work from Holy Island, there can I venture to think be no question that a base should be formed on the mainland. The scaup could be reached with greater ease. A descent could be made with the ebb tide when the scaup was being exposed and the return could be made with the help of the flowing tide when the scaup was being covered again. The mussels furthermore could be carted to the nearest station without having to take them over from the island. If at any time sea transit were to be resorted to, the fishing boats could be taken up to the mussel beds, or the mussels could be removed by smaller boats to Holy Island harbour.

With this in view I have surveyed the whole of the shore region of the Flats from the Old Law to the ford opposite Beal. The streams which enter the slake are small and of little or no use. At their points of entrance to the Flats they have to traverse a wide expanse of mud, which renders the regions concerned unnavigable except with shallow-bottomed boats and then only when the tide is in. On the other hand, the streams from the mainland and from the slakes all combine around the area known as the scaup to form a deep and wide stretch of water navigable by boats with a draft of several feet even at low tide. All this points to the base being at some convenient place on the edge of the Ford links, as near the scaup as practicable, and where an adequate supply of good spring water may be obtained. So far as I can see there will be no difficulty with regard to this latter.

I have in the previous report drawn attention to the important fact that there are no sewers leading into the slake. But the whole region next the mainland except just near the Old Law, is covered by mud, that is to say there is a broad belt of mud around the shore side of the Flats. It is an area, in fact, which if it were important enough could be with comparative ease reclaimed. There must be a good deal of putrefaction in this belt around the shore. But whether this is the reason or not, it is the case that when the mussels assemble some degree of mud together with weed, they lose that purity which our first experiences of transplantation led us to expect would be continued. Up to about January the mussels gave excellent results from the analyses made by Dr. Klein, but during the winter, as the weed

accumulated around them, the proportion of *Bacillus coli communis* of Streptococci, and of enteritidis spores appeared to gradually increase. If the mussels were to be used therefore for human food it would be necessary to keep them free from weed, and perhaps the side of the scaup next the Old Law would be found to be the best area upon which to rear mussels expressly for this purpose. At the same time, considering the exceptionally pure conditions of the region, the question may be asked, are we not after all demanding too high a standard? The late Dr. Bulstrode, whose sudden demise we all regret, was very favourably impressed with Fenham Flats in this respect.

The experiment which I propose to continue for a little longer is therefore satisfactory in that it shows that there is an immense area at present of no use except for the gathering of periwinkles, upon which a mussel farm could be formed with every prospect of success.

On May 4th, 1911, I sent the following letter to Rev. Irvine Crawshaw, vicar of Holy Island, who kindly acted as Secretary of the local Committee, which was formed in connexion with the experiment, and I now take the opportunity to thank Mr. Crawshaw and the members of the Committee for the interest they have taken.

"I had an opportunity on Saturday of inspecting the experimental mussel bed, and in spite of the fact that it was covered with weed I was very pleased with it. The results so far are (1) that the old mussels from the upper parts of the slake benefit by transplantation and can be turned into quite good bait; (2) that young mussels removed from their natural position and spread out grow at a great rate compared with those left in the original place, even when such occur on the scaup. Thus it is plain that any work expended on the area will be repaid. The only question now is as to the best means of encouraging spatting. I should recommend putting in a number of posts at various places, and a further inspection to see where spatting takes place already. Will you be good enough to communicate the gist of this to your Committee, and to ask them when they have an opportunity to visit the beds—even to try the mussels—so that we may come to some conclusion as to our future experiments, and also as to the larger problem of developing the area as a mussel farm."

THE SPAWNING OF THE COD.

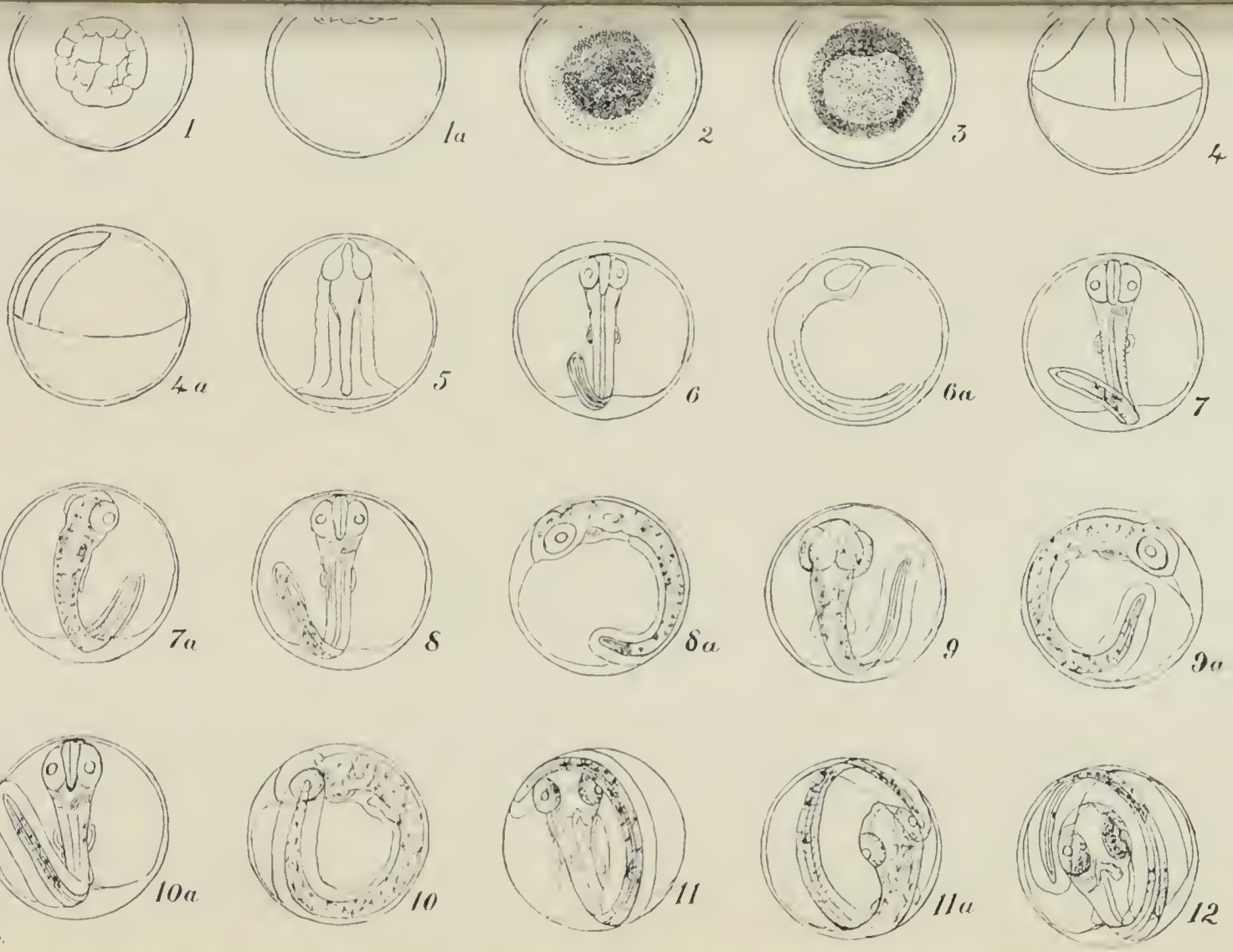
On March 20th it was found that the tank in which three codling and a number of small cole fish were kept, contained a large number of floating eggs. These proved to be the eggs of the cod.—Average diameter, 1·28 cm.

The cod were obtained as follows: Two at the trawling experiment in Blyth Bay on January 5th, 1909, and the remaining one was caught on the hook off Cullercoats on March 3rd, 1910. One of the former died on July 17th this year, and was found to be an apparently immature male measuring 19·7 inches (50·2 cm.), and an examination of the scales and the otolith showed it to be in its fourth year. The other two measured 20·7 and 20·6 inches (52·7 and 52·5 cm.) respectively and the scales which were taken from the living fish point to their being in their fifth year. It is more than probable that these two are male and female, for as will appear from what follows only one female spawned.

This was evidenced by the marked periodicity with which the spawning occurred. On the day when the eggs were first observed they were found to contain second, fifth and eighth or ninth day embryos, and this puts the beginning of spawning at about March 11th. The larvæ began to be hatched between the 23rd and the 24th, and this with many observations made during the period of egg laying showed that the interval between egg laying and hatching was usually 12 days. The average temperature of the tanks during the time was 5·5° C.

First day eggs were again obtained on the 23rd and on the 26th and the 29th, which was the last day the cod spawned. Thus during a period of about 19 days spawning took place at intervals of 3 to 4 days on six occasions. It was evident, furthermore, that the spawning took place in the early morning.

A series of figures drawn by Mr. Storrow show the advance made from day to day in the development of the embryo within the egg. The numbers appended to the



B.S. 1901.

STAGES IN THE DEVELOPMENT OF THE COD. The Figures refer to the days from spawning.

drawings indicate the number of days from spawning. These with the foregoing remarks indicate the more important results of the observations, but there is a wealth of material which we hope to have the time to return to for the purpose of a more detailed account.

It will be interesting to state here also that the plaice and the flounders similarly shed their ova into the tank in which they were kept and in the case of the plaice these were fertilised, and while a similar periodicity was evidenced this was rendered to some extent obscure by the number of plaice which were spawning at the same time. The eggs of the flounder were not fertilised.

Since the above was written, the two cod have died and were found to be, as suspected, male and female.

A SHORT ACCOUNT OF WORK ON PYCNOGONIDA DONE DURING JUNE, 1911, AT CULLERCOATS.

By VALENTINE DOGIEL, Lecturer in Zoology of the University of St. Petersburg.

During my stay at Cullercoats collections were made on the shore, and the following species were found between tide marks to the north of Cullercoats Bay:—

Phoxichilidium femoratum (Rathke) on the under surface of stones covered with Sertularia.

Anaphia petiolata (Kröyer), *ibid.*

Pallene brevirostris Johnston, *ibid.*

Phoxichilus circularis (Goodsir)?, one young specimen, *ibid.*

Nymphon rubrum Hodge, *ibid.*

Ammothea hispida (Hodge), *ibid.*

Pycnogonum littorale (Ström), on the under surface of stones covered with Clava multicornis; also often attached to Actinia and Tealia.

The development of two species, *Anaphia petiolata* and *Pycnogonum littorale* was followed. The larvæ of both species pass through a parasitic stage. In the case of *Anaphia petiolata* the six-legged larvæ which were found in the polypes of *Campanularia flexuosa* (Hincks), are characterised by the uncommonly strong development of the last joint of the second and third pair of legs, and by the complete absence of eyes. The way in which the larvæ enter the polypes was observed, and the duration of the parasitic stage was found to be from 8 to 10 days. After this period the larva moults and leaves its host. It now differs from the adult form in the absence of ovigerous legs and the incomplete development of the last pair of legs.

The parasitic stage of *Pycnogonum littorale* has not previously been observed although the species is so common, but this is perhaps due to the fact that in this stage it differs

considerably from the other species in its habits. The six-legged larvæ of Pycnogonum attach themselves to the base of the polypes of *Clava multicornis* (Forskäl) and pierce the cuticle by means of the proboscis, which is inserted into the host. The period of parasitic life, during which there are several moults, is much longer than in Anaphia. It is interesting to note that the proboscis of the larva becomes modified for this mode of life, as during the moults it grows longer and becomes curved downwards and inwards, having the form of a long tube, quite different from the proboscis of the six-legged larva and of the adult. In the last stage observed the young has all the appendages of the six-legged larva, two pairs of ambulatory legs well developed, and the third pair are represented by short outgrowths. When this stage begins to moult the contents of the first three pairs of appendages are drawn into the body, leaving no signs of their previous existence; and the cuticle of the third pair of ambulatory legs contains these limbs fully developed with claws. It is evident that after this moult the larva becomes a young Pycnogonum, differing from the adult only in the absence of the fourth pair of ambulatory legs. As such a stage has previously been observed in a free living condition,* we may assume that the life-history of Pycnogonum is now fully known. Its most characteristic feature is its ectoparasitic mode of life in the larval stages.

I take this opportunity of expressing my sincere thanks to Professor Meek and Mr. Storrow for their kindness and assistance.

* Lately observed by myself at Millport.

NOTES ON NUDIBRANCHS.

By B. STORROW.

The following notes contain records of two species not before recorded for Northumberland, observations of spawning, localities where species are particularly abundant and a note on the white variety of *Tritonia hombergii*.

Tritonia hombergii, Cuv. Three specimens of the white variety but with the typical dentition of hombergii have been obtained. One in February, 1910, picked up on the deck of a trawler which had been fishing to the east of Seaham, and two from 40 fathoms S.E. of the Coquet.

Doris tuberculata, Cuv. Is most abundant at Brown's Point, Cullercoats, and the Crab Rocks, Whitley, where large over-hanging rocks are covered on the under surface with Halichondria. It is also to be found on the south side of Cullercoats Bay, St. Mary's Island, and amongst the rocks immediately to the south of St. Mary's. The earliest dates when spawning was observed are 10th April, 1909, in the Laboratory, and 8th May, 1909, on the Crab Rocks.

Lamellidoris bilamellata (L). Is most abundant on the upper surface of flat rocks at Brown's Point and the Half Moon Rocks, Whitley, in February and March. On 3rd December, 1910, numerous large examples were found at Brown's Point and some of these spawned in the Laboratory on 8th January, 1911. The earliest date when spawning was noticed to take place on the rocks was on the Half Moon Rocks on 12th February, 1910. Then the spawn and slugs were most plentiful on the seaward side of the rocks and occurred in smaller and smaller quantities as the cracks in the rocks were followed towards the shore.

Lamellidoris aspera, A and H. Two specimens were obtained at St. Mary's Island on 22nd March, 1910, and spawned in the Laboratory on the same day. Alder and Hancock give the spawning months as May, June, and July.

Goniodoris nodosa, Montagu. This species is still probably as abundant as in the time of Alder and Hancock, for it is quite common to find in April and May as many as forty specimens under the large rocks immediately to the south of Brown's Well, Cullercoats. It is not as common in other months. Also to be found at St. Mary's Island but not in great numbers.

Antiopella cristata (Delle Chiaje). Described by Alder and Hancock as a southern form reaching its northern limit on the south western shores of our island has been obtained, October, 1910, from Blyth Harbour, where it was living amongst Laminaria on the bottom of the "Tyne," an old yacht used as a club-house by the Northumberland Yachting Club.

Eolidia papillosa, L. The commonest Eolid of the district is most abundant under small stones on the Corkscrew Rocks, Whitley, and it frequents the cracks in the shale of the same rocks in large numbers. It occurs in smaller numbers to the north of Cullercoats Bay. The earliest date when spawning was observed was on 6th March, 1909.

Hermea dendritica, A and H. Six examples of this species, not previously recorded for Northumberland, were found living in one of the tanks in the Laboratory on 24th June, 1911.

FAUNISTIC NOTES.

Calocaris macandreae, Bell. This Crustacean is evidently more common off the coast than was suspected. In 1908 it was found amongst the food of the Long Rough Dab, and this year it was obtained on June 20th in 34-35 fathoms, and on July 19th in 38 fathoms E. of St. Mary's Island. It was previously recorded by Mr. Todd from a station 57 fathoms E.N.E. of the Coquet. In both cases noted this year it bore the Polyzoon, *Triticella korenii*, G. O. Sars.

Palmipes placenta (Penn). A fine specimen was found by Mr. T. Dunn, Whitley Bay, in a basket of gurnards on North Shields Fish Quay, 6th April, 1911.

Teredo megorata, Hanley. Mr. Dunn brought also from the quay a piece of timber, which must have been got locally, for it was covered with living *Lepas anatifera*, amongst which *Teredo megorata* was found. The Lepas disappeared but the Teredo is still living in the aquarium.

B.S.

Crania of Large Tunny. Three skulls have been obtained from trawlers, one from 80 miles E. ½ N., another from 118 miles E.N.E. of the Tyne,—for the third we have no locality. One of them was sent to Dr. Boulenger who pronounced it to be the skull of a large Tunny.

It is interesting to note here also that a Bellarmine jar was got by Mr. Dunn. It was brought up in the net of the trawler "Ben Loyal" in the spring of 1910, west of the Orkneys.

PLAICE.

TABLE I—MIGRATIONS OF INSHORE FLAT FISH.

LIBERATED.						RECAPTURED.																													
						TOTAL.								MALES.								FEMALES.								SEX UNKNOWN							
							Number in								Number in								Number in								Number in						
Date.	Place.	Number.	Largest.	Mean.	Smallest.	Migration in Miles.	1st 6 mo.	2nd 6 mo.	3rd 6 mo.	4th 6 mo.	2 yrs. +	Largest.	Mean.	Smallest.	Migration in Miles	1st 6 mo.	2nd 6 mo	3rd 6 mo.	4th 6 mo.	2 yrs. +	Largest.	Mean.	Smallest.	Migration in Miles.	1st 6 mo.	2nd 6 mo.	3rd 6 mo.	4th 6 mo.	2 yrs. +	Largest.	Mean.	Smallest.	Migration in Miles.	1st 6 mo.	2nd 6 mo.	3rd 6 mo.	4th 6 mo.	2 yrs. +	Largest.	Mean.	Smallest.
1903 26 June	Goswick Bay.	16	28·6	23·2	15·3	0— 5 5—10 10+		4 1			1	28·2 39·9	33·9	26 29	0— 5 5—10 0+		1 1		1		28·2 39·9		33	0— 5 5—10 10+	1	1				26 29			0— 5 5—10 10+		2				?		
26 June	Skate Roads.	2	26·7		19·7	0— 5 5—10 10+		1				30·6			0— 5 5—10 10+		1				30·6			0— 5 5—10 10+									0— 5 5—10 10+								
1 July	Alnmouth Bay	22	25·8	21·3	19	0— 5 5—10 10+		1	1			33		23·5	0— 5 5—10 10+									0— 5 5—10 10+		1				23·5			0— 5 5—10 10+			1			33		
9 July	Cambois Bay	4	28	21·5	15·2	0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+								
15 July	Druridge Bay	34	32·7	21	17·5	0— 5 5—10 10+		1 1	1 3	 1		33 25·2 44·2	36·4	22·8 29·6	0— 5 5—10 10+		1	 1			22·8 37·5			0— 5 5—10 10+			1 1	 1		33 34·2		29·6	0— 5 5—10 10+		1	 1			25·2 44·2		
23 July	Blyth Bay	66	29·8	23	18·4	0— 5 5—10 10+	*4	9 1		1		32·4 26·3	25·9	23·2	0— 5 5—10 10+		5				27·9	25·3	23·2	0— 5 5—10 10+		3 1		1		32·4 26·3	26·75	23·5	0— 5 5—10 10+	*4	*1				?		?
4 Aug.	Skate Road	42	29·2	22·5	17·5	0— 5 5—10 10+		8		1	 1	33 41·5	27	20·6	0— 5 5—10 10+		3			 1	29·2 41·5	25·1	20·6	0— 5 5—10 10+		4		1		33	28·2	24·4	0— 5 5—10 10+		1				?		
12 Aug.	Druridge Bay	40	28·6	21·3	12·7	0— 5 5—10 10+		1				30·6			0— 5 5—10 10+									0— 5 5—10 10+		1				30·6			0— 5 5—10 10+								
19 Aug.	Alnmouth Bay	63	26	20·3	13·4	0— 5 5—10 10+			1			29			0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+			1			29		
26 Aug.	Cambois Bay	40	26·7	21	15·6	0— 5 5—10 10+				1		34·3			0— 5 5—10 10+									0— 5 5—10 10+				1		34·3			0— 5 5—10 10+								
2 Sept.	Blyth Bay	57	27·3	22·7	17·8	0— 5 5—10 10+		8				34·2	28·3	22·3	0— 5 5—10 10+		4				28·2	25·6	22·3	0— 5 5—10 10+									0— 5 5—10 10+		*4				34·2		33
9 Sept.	Druridge Bay	84	29·9	21·5	15	0— 5 5—10 10+	2	13	1			33	24·9	18	0— 5 5—10 10+	1	7				28·8	24·7	22·2	0— 5 5—10 10+		5	1			33	25·7	18	0— 5 5—10 10+	1	1				22·3		
1901. 20 July	Cambois Bay	7	30	24	18·5	0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+								
1902. 28 July	Skate Roads	54	35	23·9	16	0— 5 5—10 10+	1 1	4				27·7 33·2	25	22	0— 5 5—10 10+	1	1				27·7		25·5	0— 5 5—10 10+	1	3				26·6 33·2	24	22	0— 5 5—10 10+								

* No Measurements.

DABS.

TABLE II.—MIGRATION OF INSHORE FLAT FISH.

LIBERATED.						RECAPTURED.																																			
						TOTAL.									MALES.									FEMALES.									SEX UNKNOWN								
							Number in									Number in									Number in									Number in							
Date.	Place.	Number.	Largest.	Mean.	Smallest.	Migration in Miles.	1st 6 mo.	2nd 6 mo.	3rd 6 mo.	4th 6 mo.	2 yrs. +	Largest.	Mean.	Smallest.	Migration in Miles.	1st 6 mo.	2nd 6 mo.	3rd 6 mo.	4th 6 mo.	2 yrs. +	Largest.	Mean.	Smallest.	Migration in Miles.	1st 6 mo.	2nd 6 mo.	3rd 6 mo.	4th 6 mo.	2 yrs. +	Largest.	Mean.	Smallest.	Migration in Miles.	1st 6 mo.	2nd 6 mo.	3rd 6 mo.	4th 6 mo.	2 yrs. +	Largest.	Mean.	Smallest.
1903 1 July	Alnmouth Bay	8	21·6	20·8	20	0–5		1				21·6			0–5									0–5		1				21·6			0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
9 July	Cambois Bay	1	15·2			0–5									0–5									0–5									0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
1904 24 June	Cambois Bay	39	27	20·8	16	0–5									0–5									0–5									0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
6 July	Druridge Bay	71	26·5	21·3	17	0–5	4		1			26·7	25	23	0–5									0–5	4		1			26·7	25	23	0–5								
						5–10									5–10									5–10									5–10								
						10+	1					23			10+	1					23			10+									10+								
13 July	Alnmouth Bay	27	24	20·4	17	0–5									0–5									0–5									0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
20 July	Cambois Bay	48	25	19·8	16	0–5									0–5									0–5									0–5								
						5–10									5–10									5–10									5–10								
						10+	1					17·8			10+	1					17·8			10+									10+								
1 Aug.	Skate Roads	46	25·25	20·2	17	0–5									0–5									0–5									0–5								
						5–10									5–10									5–10									5–10								
						10+			1			27			10+									10+			1			27			10+								
10 Aug.	Druridge Bay	52	27	21·6	18	0–5	4					25·5	22·7	19	0–5									0–5	4					25·5	22·7	19	0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
17 Aug.	Blyth Bay	54	25·25	21·6	17	0–5	3					22·3	21·6	21	0–5									0–5	3					22·3	21·6	21	0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
24 Aug.	Cambois Bay	44	21·75	18·5	16	0–5	1					21·6			0–5									0–5	1					21·6			0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
7 Sept.	Alnmouth Bay	51	23·25	20·25	15·2	0–5	1					22·2			0–5									0–5	1					22·2			0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
1905 30 June	Cambois Bay	31	23·5	20·3	16	0–5	2					?			0–5									0–5	1					?			0–5	1					?		
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
12 July	Alnmouth Bay	37	23	19·1	16	0–5									0–5									0–5									0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
19 July	Druridge Bay	43	23·7	19·6	16·2	0–5									0–5									0–5									0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
26 July	Blyth Bay	77	24	19·5	16·7	0–5	5					21	19	18	0–5	1					19			0–5	4					21	19	18	0–5								
						5–10									5–10									5–10									5–10								
						10+	1					25·6			10+									10+	1					25·6			10+								
2 Aug.	Druridge Bay	29	25	19·4	16	0–5	1					23			0–5	1					23			0–5									0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
7 Aug.	Skate Roads	1	20			0–5									0–5									0–5									0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
16 Aug.	Alnmouth Bay	29	23·8	19·1	17·5	0–5									0–5									0–5									0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
23 Aug.	Cambois Bay	11	22·5	18·7	15·3	0–5									0–5									0–5									0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
23 Aug.	Blyth Bay	28	24·5	19·3	16·8	0–5									0–5									0–5									0–5								
						5–10									5–10									5–10									5–10								
						10+	1					19			10+									10+	1					19			10+								
6 Sept.	Druridge Bay	4	20·5	19·6	18	0–5									0–5									0–5									0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
1906 18 July	Alnmouth Bay	27	26	19·9	16·7	0–5	4	1				20		19·5	0–5	2					20		19·5	0–5	2	1				?	?	?	0–5								
						5–10									5–10									5–10									5–10								
						10+	1	1				23·5		20·3	10+									10+	1	1				23·5		20·3	10+								
22 Aug.	Druridge Bay	1	21·5			0–5									0–5									0–5									0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
1907 24 Aug.	Alnmouth Bay	8	23·5	20·7	18·2	0–5									0–5									0–5									0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								
4 Sept.	Skate Roads	1	22·5			0–5									0–5									0–5									0–5								
						5–10									5–10									5–10									5–10								
						10+									10+									10+									10+								

FLOUNDER.

TABLE III—MIGRATIONS OF INSHORE FLAT FISH.

LIBERATED.						RECAPTURED.																													
						TOTAL.								MALES.								FEMALES.								SEX UNKNOWN.							
						Number in								Number in								Number in								Number in							
Date.	Place.	Number.	Largest.	Mean.	Smallest.	Migration in Miles.	1st 6 mo.	2nd 6 mo.	3rd 6 mo.	4th 6 mo.	2 yrs. +	Largest.	Mean.	Smallest.	Migration in Miles	1st 6 mo.	2nd 6 mo	3rd 6 mo.	4th 6 mo.	2 yrs. +	Largest.	Mean.	Smallest.	Migration in Miles.	1st 6 mo.	2nd 6 mo.	3rd 6 mo.	4th 6 mo.	2 yrs. +	Largest.	Mean.	Smallest.	Migration in Miles.	1st 6 mo.	2nd 6 mo.	3rd 6 mo.	4th 6 mo.	2 yrs. +	Largest	Mean.	Smallest.
1904 13 July	Alnmouth Bay	24	30	24	17	0— 5 5—10 10+	2					20·2			0— 5 5—10 10+	1					20·2			0— 5 5—10 10+	1					?			0— 5 5—10 10+								
10 Aug.	Druridge Bay	1	26			0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+								
1905 30 June	Cambois Bay	3	23	22	20	0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+								
12 July	Alnmouth Bay	2	21·5		18·5	0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+								
19 July	Druridge Bay	7	34·5	27·2	18·2	0— 5 5—10 10+	1					27·2			0— 5 5—10 10+	1					27·2			0— 5 5—10 10+									0— 5 5—10 10+								
26 July	Blyth Bay	15	28·7	22·2	16	0— 5 5—10 10+	6	1	1			28·8	24·8	21·5	0— 5 5—10 10+	2					28·8	26·4	24	0— 5 5—10 10+	2	1	1			26·2	24·1	21·5	0— 5 5—10 10+	2					?		
2 Aug.	Druridge Bay	1	21			0— 5 5—10 10+	1					21			0— 5 5—10 10+									0— 5 5—10 10+	1					21			0— 5 5—10 10+								
7 Aug.	Skate Roads	2	27	25·5	24	0— 5 5—10 10+		1				27·7			0— 5 5—10 10+		1				27·7			0— 5 5—10 10+									0— 5 5—10 10+								
16 Aug.	Alnmouth Bay	12	36	23·1	16	0— 5 5—10 10+	1					? 18·5			0— 5 5—10 10+		1				18·5			0— 5 5—10 10+	1					?			0— 5 5—10 10+								
1906 18 July	Alnmouth Bay	3	42	31·5	23	0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+								
25 July	Blyth Bay	23	34·3	25·8	20	0— 5 5—10 10+	7	2 2				34 29·8	27·3	23 27	0— 5 5—10 10+	2	1 2				27·5 29·8	25·2	23 27	0— 5 5—10 10+	3	1				34	29·6	23	0— 5 5—10 10+	2					24		?
1 Aug.	Alnmouth Bay	27	44	23·6	17	0— 5 5—10 10+	10	1 1				29 24·7 44	19·9	19·7	0— 5 5—10 10+	1					20			0— 5 5—10 10+	2	1 1				20 24·7 44		19·7	0— 5 5—10 10+	7					?	?	?
22 Aug.	Druridge Bay	2	27·7		23	0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+								
29 Aug.	Skate Roads	64	43·5	29·9	23	0— 5 5—10 10+	3 2	1 5	1 1	1		35·8 36	31·9 32	30 27·5	0— 5 5—10 10+	1 2	 2				? 34·2	31·5	27·5	0— 5 5—10 10+	2	1 1	1			31·5 36	30·6	30 34·7	0— 5 5—10 10+		1 2	 1			35·8 33		?
12 Sept.	Blyth Bay	35	29·5	23·3	17·5	0— 5 5—10 10+		5				30·2	26·1	25	0— 5 5—10 10+		3				26·2	25	23·9	0— 5 5—10 10+		2				30·2		25·2	0— 5 5—10 10+								
1907 19 Aug.	Druridge Bay	1	26·2			0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+									0— 5 5—10 10+								
24 Aug.	Alnmouth Bay	13	25	21·2	17	0— 5 5—10 10+		2				25·5		21	0— 5 5—10 10+		1				25·5			0— 5 5—10 10+		1				21			0— 5 5—10 10+								
29 Aug.	Skate Roads	27	46	30·3	23	0— 5 5—10 10+	1	3				32·5 29 6	28·8	28	0— 5 5—10 10+	1	2				32·5 29·6	28·8	28	0— 5 5—10 10+									0— 5 5—10 10+								
4 Sept.	Skate Roads	34	47	30·2	21	0— 5 5—10 10+		1	1			28 32			0— 5 5—10 10+			1			28			0— 5 5—10 10+		1							0— 5 5—10 10+	1					?		
6 Sept.	Blyth Bay	15	31	25	19	0— 5 5—10 10+	1		1			26·9		22	0— 5 5—10 10+									0— 5 5—10 10+						32			0— 5 5—10 10+								
14 Sept.	Blyth Bay	1	24			0— 5 5—10 10+		1				24			0— 5 5—10 10+		1				24			0— 5 5—10 10+	1		1			26·9		22	0— 5 5—10 10+								
20 Sept.	Blyth Bay	49	33·75	24·4	18	0— 5 5—10 10+	2	3 1				31 ?	27·3	22·4	0— 5 5—10 10+		1				22·4			0— 5 5—10 10+	2	2				31	28·5	24·7	0— 5 5—10 10+								
27 Sept.	Skate Roads	21	42·5	31·7	26·2	0— 5 5—10 10+		1 1				27·5 30·4			0— 5 5—10 10+									0— 5 5—10 10+		1 1				27·5 30·4			0— 5 5—10 10+	1					?		

TABLE IV—MIGRATIONS OF INSHORE FLAT FISH.

LIBERATED.						RECAPTURED.																											
						TOTAL.								MALES.								FEMALES.									SEX UNKNOWN.					
							Number in							Number in								Number in								Number in					
Date.	Place.	Number.	Largest.	Mean.	Smallest.	Migration in Miles.	1st 6 mo.	2nd 6 mo.	3rd 6 mo.	4th 6 mo.	2 yrs. +	Largest.	Mean.	Smallest.	Migration in Miles.	1st 6 mo.	2nd 6 mo	3rd 6 mo.	4th 6 mo.	2 yrs. +	Largest.	Mean.	Smallest.	Migration in Miles.	1st 6 mo.	2nd 6 mo.	3rd 6 mo.	4th 6 mo.	2 yrs. +	Largest.	Mean.	Smallest.	Migration in Miles.	1st 6 mo.	2nd 6 mo	3rd 6 mo.	4th 6 mo.	2 yrs. +	Largest	Mean.	Smallest.
1903. 15 July	Druridge Bay	1	21	...	...	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
1904. 10 Aug.	Druridge Bay	1	24	...	...	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
24 Aug.	Cambois Bay	1	17·5	...	...	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
7 Sep.	Alnmouth Bay	2	24·5	...	23	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
1905. 19 July	Druridge Bay	10	31·5	29·4	26	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
26 July	Blyth Bay	3	27·5	27·2	27	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
2 Aug.	Druridge Bay	15	31	28·5	26	0— 5 5—10 10+	1		1		2	32·8 36·2 52	46·5	40·9	0— 5 5—10 10+	1		1		1	32·8 36·2 40 9			0— 5 5—10 10+					1	52			0— 5 5—10 10+							
7 Aug.	Skate Roads	6	28·4	25·8	22·3	0— 5 5—10 10+	1					30·5 ?			0— 5 5—10 10+								0— 5 5—10 10+	1					30·5 ?			0— 5 5—10 10+							
16 Aug.	Alnmouth Bay	1	28	...	...	0— 5 5—10 10+	+								0— 5 5—10 10+								0— 5 5—10 10+	+								0— 5 5—10 10+							
6 Sept.	Druridge Bay	1	26	...	...	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
1906. 18 July	Alnmouth Bay	12	31	21·9	20	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
25 July	Blyth Bay	2	29	...	27·5	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
29 Aug.	Skate Roads	3	29·5	27·9	21.25	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
5 Sept.	Druridge Bay	1	17·6	...	...	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
1907. 19 Aug.	Druridge Bay	1	22·3	...	...	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
29 Aug.	Skate Roads	2	29	...	28·5	0— 5 5—10 10+					1	43·8			0— 5 5—10 10+								0— 5 5—10 10+					1	43·8			0— 5 5—10 10+							
4 Sept.	Skate Roads	3	28·5	28·3	28	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
6 Sept.	Blyth Bay	4	29·5	29·75	16	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
20 Sept.	Blyth Bay	10	29·5	21·8	15	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
27 Sept.	Skate Roads	2	26	25	24	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
1908 16 Sept.	Druridge Bay	2	22	21·5	21	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								
1908. 28 July	Skate Roads	2	29	28	27	0— 5 5—10 10+									0— 5 5—10 10+								0— 5 5—10 10+								0— 5 5—10 10+								

TABLE V.—MIGRATIONS OF INSHORE FLAT FISH.

Name of Fish.	Number Liberated.	Number Recaptured.	% Recaptured.	Recaptured.	MALES. Migration in Miles.	MALES. Mean of all Recaptured.	MALES. Largest.	MALES. Mean.	MALES. Smallest.	FEMALES. Largest.	FEMALES. Mean.	FEMALES. Smallest.	
PLAICE	531	76	14·1	64	0—5	26·6	29·2	25·5	...	34·3	27	...	
				2	5—10	25·7	...	...	...	26·3	...	...	One sex unknown.
				9	10+	35·8	41·5	38	33	34·2	31·5	29	One caught numbered label wanting ; 1905, p. 54.
DAB	768	37	4·8	28	0—5	21·9	23	20·4	...	26·7	22·2	...	
				...	5—10	...	...	...	...	...	...	...	One 20·6, with no date or locality ; 1906, p. 24.
				7	10+	22·3	23	20·4	17·8	27	23·1	19	One with numbered portion of label lost ; 1904, p. 80.
FLOUNDER	382	77	20·2	54	0—5	26·2	32·5	25·4	...	34	26·4	...	
				3	5—10	26·1	...	...	...	...	26·1	...	One with no label ; 1905, p. 57.
				19	10+	30·7	34·2	28·3	18·5	44	3 ·4	30·4	
TURBOT	85	6	7	2	0—5	31·6	...	32·8	...	...	30·5	...	
				1	5—10	36·2	...	36·2	...	...	...	...	
				3	10+	48·9	...	40·9	...	52	47·9	43·8	

CRABS.

TABLE VI.—MIGRATIONS OF CRABS AND LOBSTERS.

LIBERATED. Date.	Place.	Number.	RECAPTURED. TOTAL. Migration in Miles.	Number in 1st 6 mo.	2nd 6 mo.	3rd 6 mo.	4th 6 mo.	2 yrs. +	N	NE	E	MALES. Migration in Miles.	Number in 1st 6 mo.	2nd 6 mo.	3rd 6 mo.	4th 6 mo.	+	N	NE	E	FEMALES. Migration in Miles.	Number in 1st 6 mo.	2nd 6 mo.	3rd 6 mo.	4th 6 mo.	2 yrs. +	N	NE	E	
11 Oct. 1902 to 23 Jan. 1903	Beadnell Beach	145	0— 5	10				3			2	0— 5	8				3			1	0— 5	2							1	
			5—10	2								5—10	1								5—10	1								
			10+	1	1				2			10+									10+	1	1				2			
15 Oct. 1904 to 22 Oct. 1904	Beadnell Beach	196	0— 5	9								0— 5	9								0— 5									
			5—10	1							1	5—10	1							1	5—10									
			10+	3	1				4			10+									10+	3	1				4			
1905 28 Oct	Beadnell Beach	100	0— 5	14	1							0— 5	2	1							0— 5	12								
			5—10									5—10									5—10									
			10+		6*				6			10+									10+		5				5			* One with label only 1906, p. 27
1905 11 Oct. to 6 Nov.	Near Craster	100	0— 5	8*	5			1				0— 5	6	5			1				0— 5	1								
			5—10	2*					1	1		5—10									5—10	1						1		* Sex not known in one
			10+		2				2			10+									10+		2				2			* Sex not known in one
1905 23 Oct. to 25 Oct.	Hauxley Haven	100	0— 5									0— 5									0— 5									Two reported recaptured and returned numbers not being noted
			5—10									5—10									5—10									
			10+									10+									10+									
1905 19 Oct. to 10 Nov.	Newbiggin Low Water Mark	79	0— 5	1	3*							0— 5	1	1							0— 5									* Sex unknown in 2
			5—10		1*							5—10									5—10									* Sex not known, migrated 9 miles S.
			10+				1		1			10+									10+				1		1			
1905 22nd Sept. to 26 Dec.	Sea Houses	61	0— 5	2*								0— 5									0— 5	1								
			5—10	1						1		5—10									5—10	1						1		* Sex not known in 1
			10+									10+									10+									

LOBSTERS.

1902 28 April to 4 July	Beadnell and opposite Sea Houses	100	0— 5	12								0— 5	8								0— 5	4								
			5—10									5—10									5—10									
			10+									10+									10+									
1907 10 Oct. to 13 Dec.	Beadnell	100	0— 5	28	8							0— 5	17	5							0— 5	11	3							
			5—10									5—10									5—10									
			10+									10+									10+									
1907 13 Nov. to 13 Mar. 1908	Sea Houses	38	0— 5	2	1							0— 5									0— 5	2	1							
			5—10									5—10									5—10									
			10+									10+									10+									
1909 1 June to 15 June	N Sunderland Point and Beadnell	74 Berried Hens	0— 5	4	9							0— 5									0— 5	4	9							5 others in addition but Labels lost, 1909-10, p. 23.
			5—10		1				1			5—10									5—10		1				1			
			10+									10+									10+									

TABLE VII.—MIGRATIONS OF CRABS AND LOBSTERS.

	Number Liberated	Number Re-captured	% Re-captured	Migration in Miles	Re-captured	DIRECTION OF MIGRATION. FOR ALL RECAPTURED N	NE	E	MALES Number	N	NE	E	FEMALES Number	N	NE	E	
CRABS	781	79	10	0—5	57				37				16				4 Sex unknown.
				5—10	7	1	2	3	2			2	3		2	1	2 Sex unknown one of which went 9 miles S.
				10+	15	15							14	14			One label only returned.
LOBSTERS	312	65	21	0—5	64				30				34				
				5—10	1	1							1	1			
				10+													

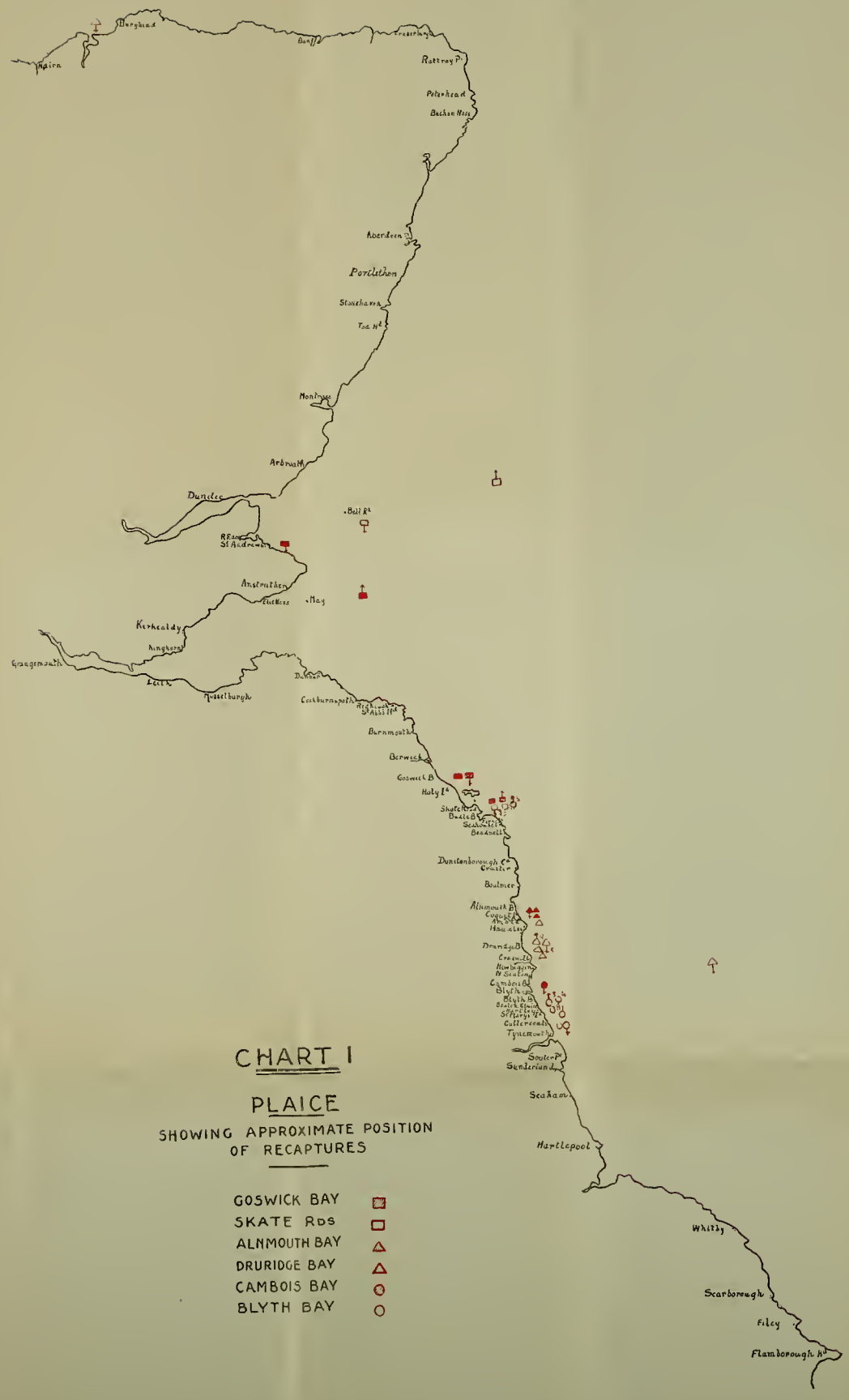


CHART I

PLAICE

SHOWING APPROXIMATE POSITION OF RECAPTURES

GOSWICK BAY
SKATE RDS
ALNMOUTH BAY
DRURIDGE BAY
CAMBOIS BAY
BLYTH BAY

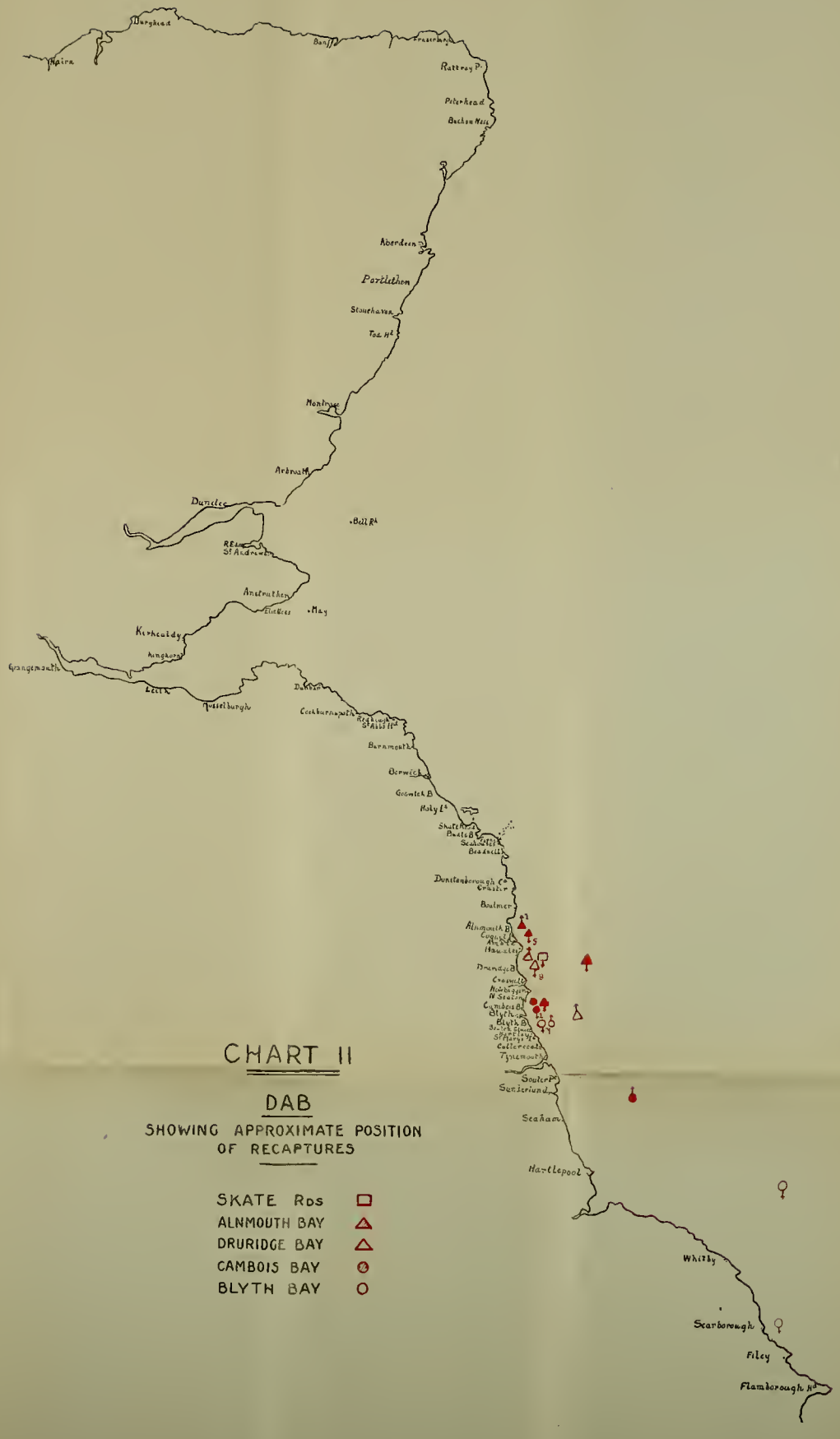


CHART II

DAB

SHOWING APPROXIMATE POSITION OF RECAPTURES

SKATE Rds □
ALNMOUTH BAY △
DRURIDGE BAY △
CAMBOIS BAY ⊗
BLYTH BAY ○

CHART III

FLOUNDER

SHOWING APPROXIMATE POSITION OF RECAPTURES

SKATE Rds □

ALNMOUTH BAY ▲

DRURIDGE BAY △

BLYTH BAY ○

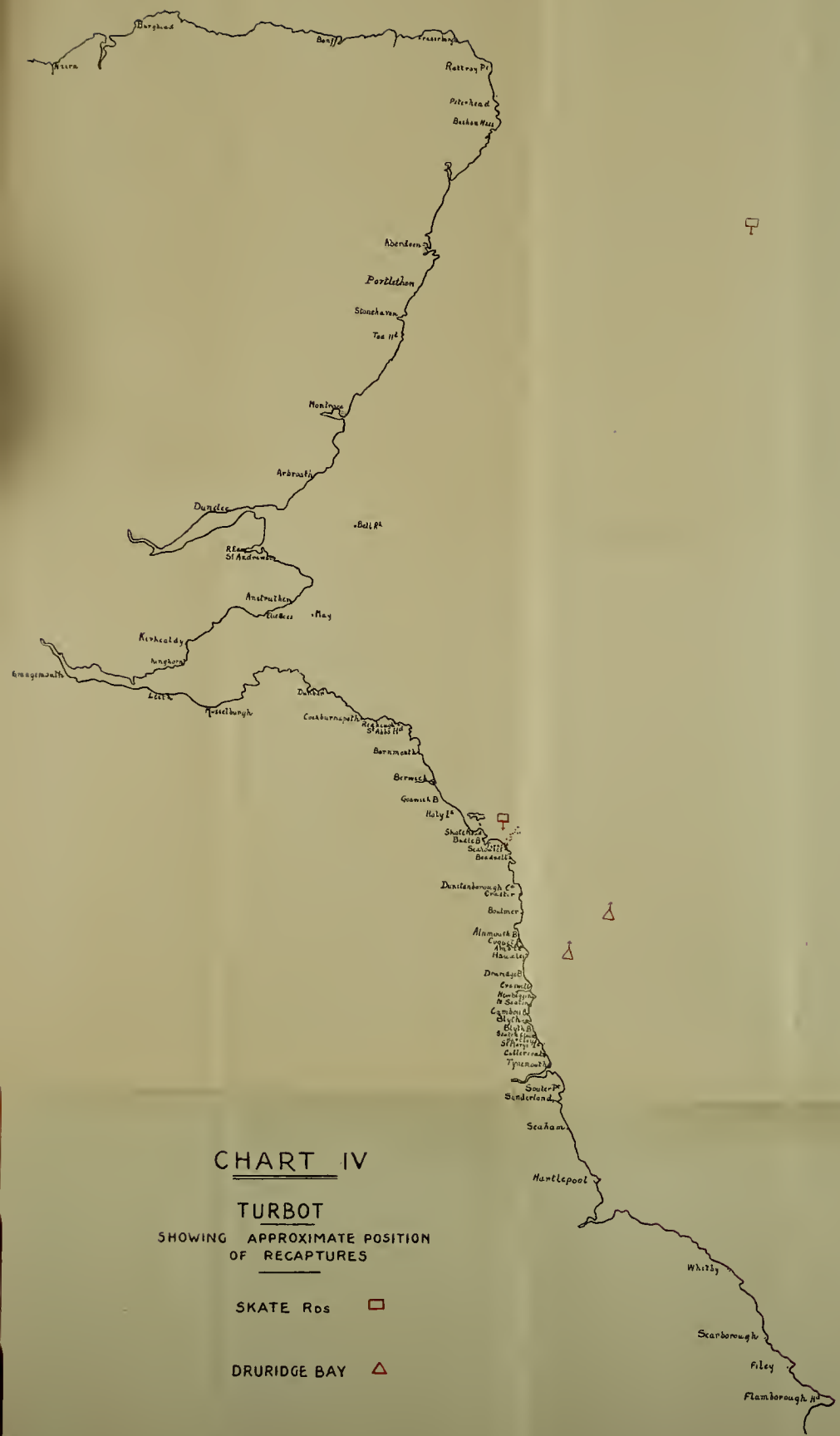


CHART IV

TURBOT

SHOWING APPROXIMATE POSITION OF RECAPTURES

SKATE Rds

DRURIDGE BAY

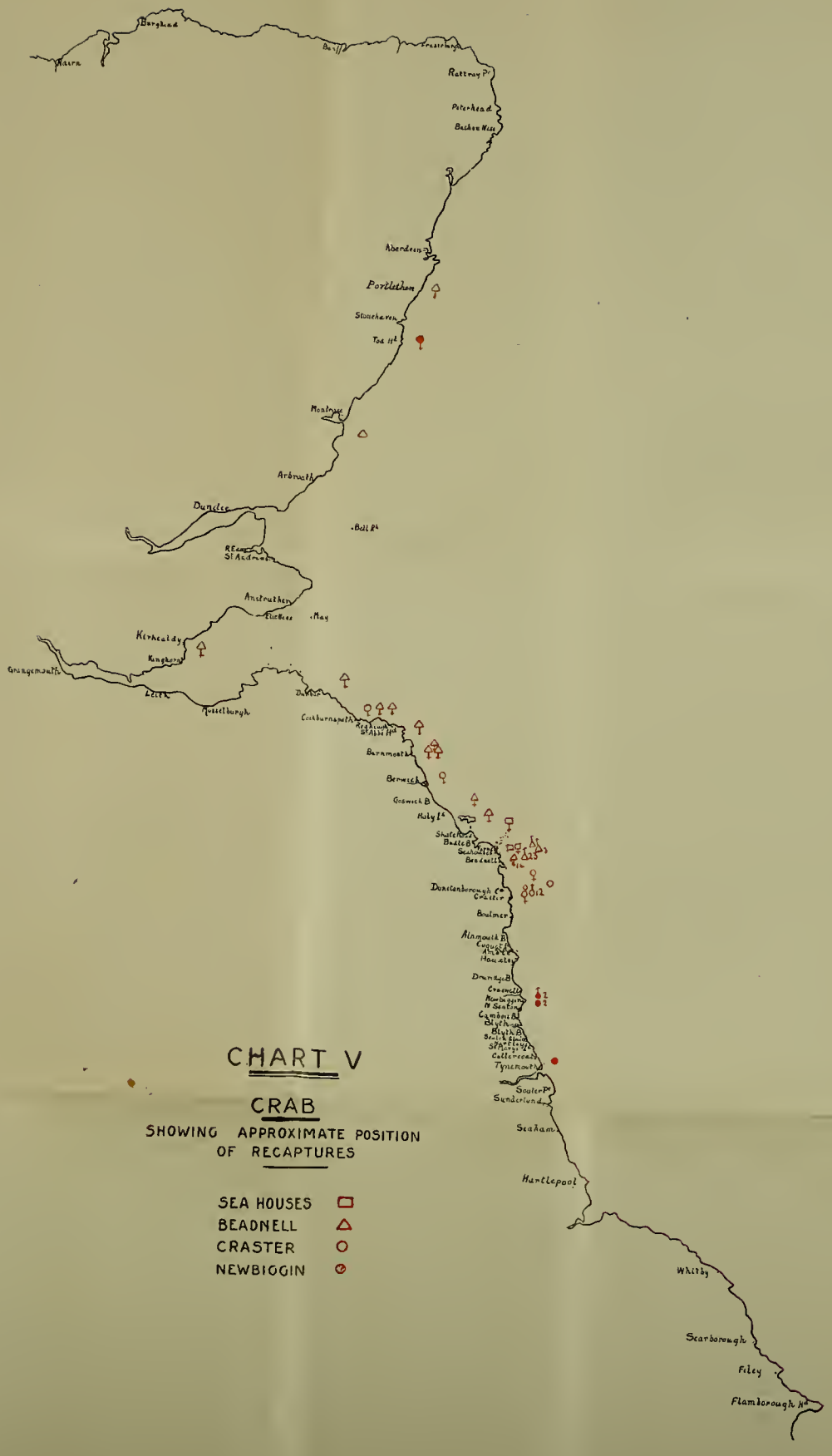


CHART V

CRAB

SHOWING APPROXIMATE POSITION OF RECAPTURES

SEA HOUSES
BEADNELL
CRASTER
NEWBIGGIN